Space Weather Technical Forecast

Issued on Sunday 16 March 2025 at 00:48 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: M-class flares likely. Chance G1/Minor Storms Days 1-2 (16-17 Mar). Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low, with only a few C-class flares observed, despite there being thirteen regions currently on the visible disc. Peak flare was a long C4.1 at 15/1741 from AR4019 in the northwest. This region has seen its negative spots decline, and has simplified to a more typical bipolar configuration. The most notable development was in AR4021 in the south-centre with the emergence of small spots on its southwestern edge, leading to the region complexifying into a being a small bipolar group. Small growth was also observed in the intermediate spots of AR4028 in the southeast, and three new regions were also numbered, all in the northeast quadrant

No Earth-directed CMEs have been observed in available imagery. A large CME was observed just over the southwest limb, associated with a long period C3.9 flare at 15/0647 UTC.

Solar Wind / Geomagnetic Activity: Ongoing fast wind of CH22/- was observed. Speed as measured by ACE at L1, was elevated, between 500-570 km/s, but eased to be slightly elevated from 15/2000 UTC, at around 480km/s. Density was below average. Interplanetary Magnetic Field, Bt, was weak below 7nT, with the north-south component, Bz, also weak and variable, ranging +6/-5nT. Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Active (Kp4) until 15/1200 UTC, then eased to be Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at background. High energy electron flux (greater than 2 MeV) was Moderate to High, with the main High period 15/1105-2225 UTC, peaking of 4950 pfu at 15/1545 UTC. The 24-hour fluence became Active (above 1e8 integrated pfu) from 15/0300UTC with a rising trend continuing, reaching 1.38e8 integrated pfu at 16/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with isolated M-class flares likely. There is a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Ongoing fast winds may ease a little day 1 (16 Mar), before a further enhancement is likely later day 1 or day 2 (16-17 Mar) from any fast winds and CIR associated with CH23/- in the south disc. This is enhancement is low

---

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

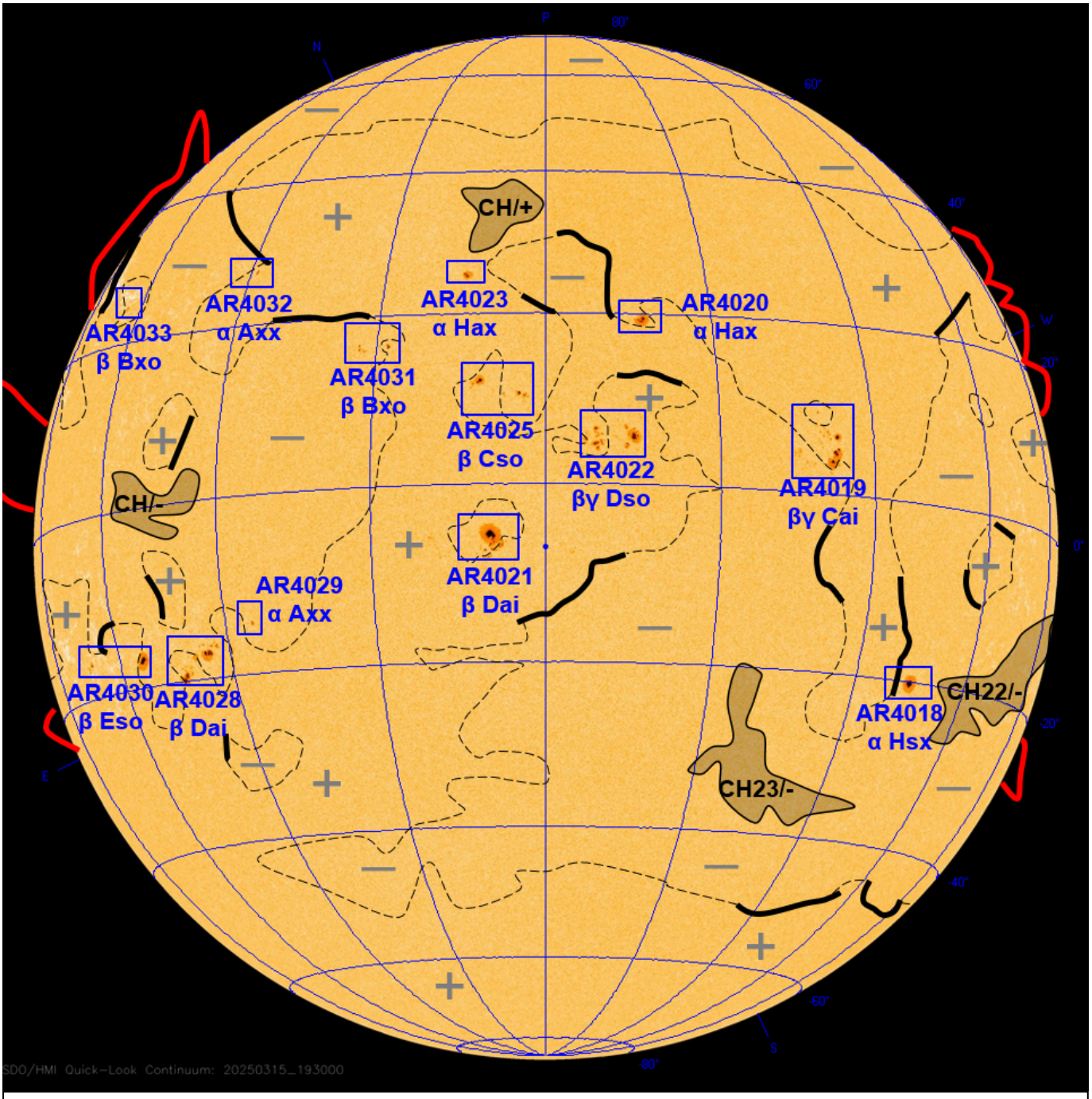
confidence, however. Solar winds then easing towards background day 3-4 (18-19 Mar). Mainly Quiet to Unsettled geomagnetic activity is likely at first, with a chance of isolated Active intervals, but also a chance for a spell of Active to G1 Minor Storms, most likely on day 2 (17 Mar). Conditions easing to be mainly Quiet by day 4 (19 Mar).

Energetic Particles / Solar Radiation: High energy proton flux is expected to be background. High energy electron flux is expected to reach High levels at the diurnal maxima, with Active (1e8 integrated pfu) fluence continuing day 1-2 (16-17 Feb) before likely easing. However confidence lowers later in the period.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 1: MOSWOC Solar Synoptic Map 15/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Geomagnetic Storms

There are no Earth-directed CMEs.

The fast wind enhancement from CH22/- continues, with only limited easing being observed. Speeds are slightly elevated at time of issue, around 460 km/s, and are likely to continue easing a little through day 1 (16 Mar). The next enhancement is potentially from any fast wind from the northern extension of CH23/-. The leading edge of this northern section of the coronal hole is located around 25-30W at time of writing this forecast, and with potential solar winds of 500-600km/s, this would result in any CIR onset and subsequent solar wind enhancement occurring either late day 1 or more likely day 2 (16-17 Mar).

This is low confidence however, both due to the feature being located further south than CH22/- which brought the more recent enhancement, but also as this feature was observed only as a continuation of the previous fast wind enhancement, as a single feature on the previous solar rotation. Furthermore MOSWOC Enlil suggests solar winds will see the current fast winds persisting until day 2 (17 Mar) before likely easing to background speeds by day 4 (19 Mar) .

Mainly Quiet to Unsettled geomagnetic activity is likely at first, with a chance of isolated Active intervals, but also a chance for a spell of Active to G1 Minor Storms should any further fast wind enhancement occur, most likely on day 2 (17 Mar). Conditions then easing to be mainly Quiet by day 4 (19 Mar).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	30	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 2: MOSWOC Enlil

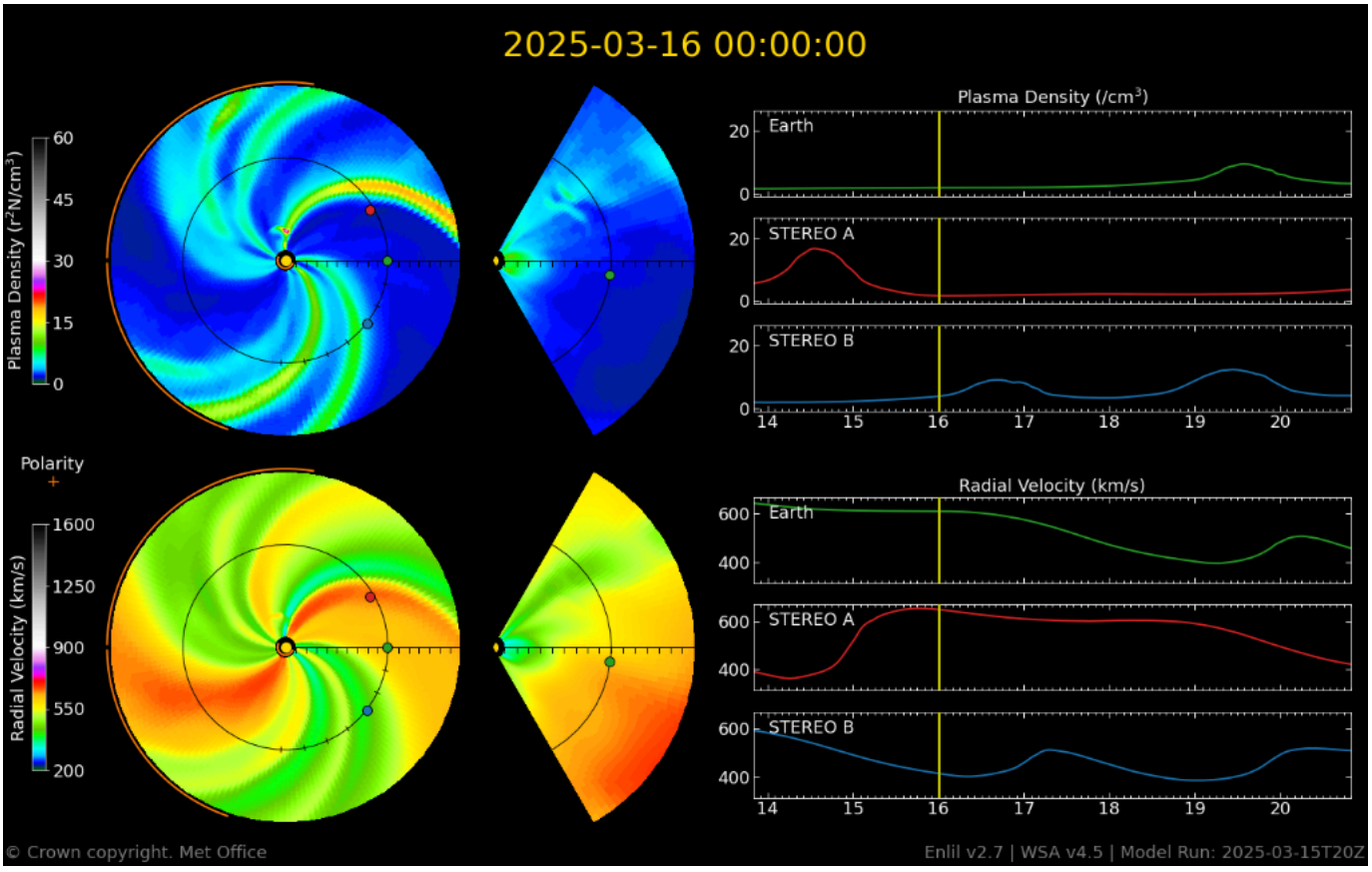
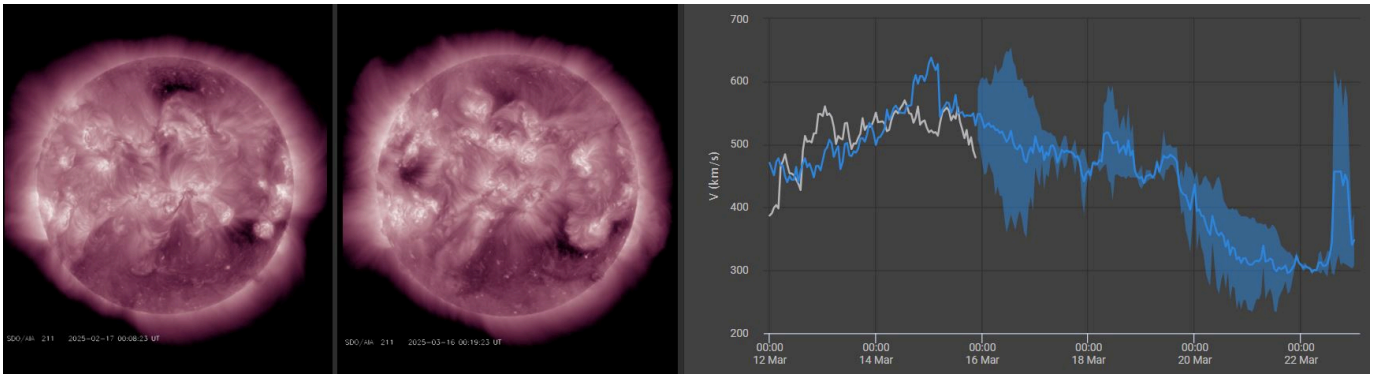


Figure 3: SDO aia-211 of previous rotation (left), current rotation (middle) and 27-day solar wind persistent model. Enhancement shown on 18 Mar, was due to a CME arrival on the previous rotation. Otherwise easing winds expected.



© Crown Copyright 2025. All Rights Reserved.

Radio Blackouts - X-Ray Flares

There are currently thirteen regions on the Earth-facing disc.

The most notable region is now AR4021 in the south centre disc. After recently maturing to a simple unipolar spot, a further flux emergence has occurred on its southwestern edge. This not only complexifies the region into a bipolar spot but also into an anti-Hale cycle spot with the opposite orientation to what would be expected for a southern disc region. Further growth around this emergence has the potential to develop into a complex and unstable region. However, at the moment, this remains a relatively small region and stable region.

Previously of interest, AR4019 is now in the northwest disc, and has seen its negative polarity spots fade reducing the overall complexity of the region, which has also remained inactive. However the north-south alignment of its associated magnetic looping in SDO imagery, suggests the potential for shear across the field lines, that could also allow for some increased activity. A few regions have seen some limited growth, including AR4028 in the southeast with the emergence of small intermediate spots, AR4022 in the north-centre although this remained a simple bipolar region, and a collection of small newly numbered regions AR4032 abd AR4033 in the northwest.

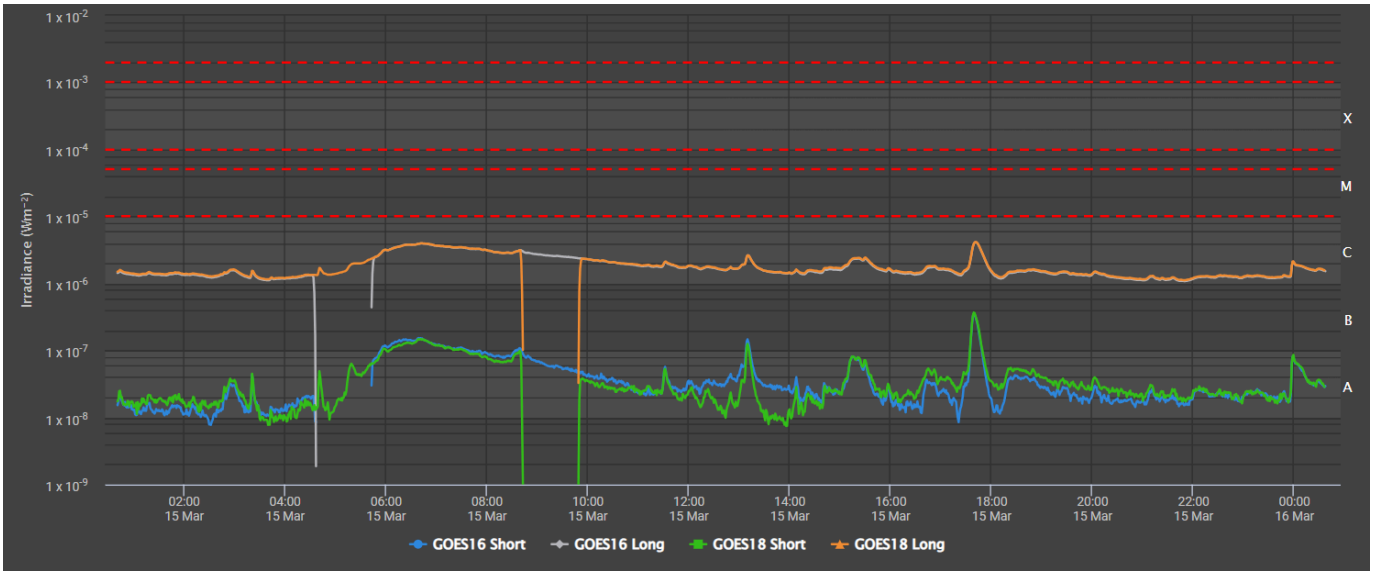
Despite this activity has remained Low in the last 24 hours. However, isolated M-flares remain likely and there is a slight chance of X-class flares.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	60	60	60	60
Very Active	R3-R5 (X Class)	No	10	10	10	10

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 4: GOES-16/18 X-ray Irradiance.



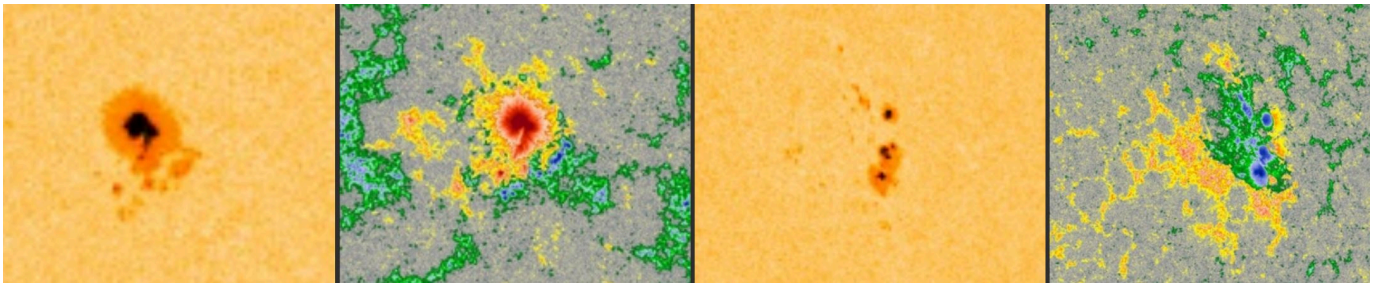
© Crown Copyright 2025. All Rights Reserved.

Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to remain at background with only a very slight chance of enhancement due to the current inactivity of the small regions on the Earth-facing disc. However, as more of these move into the western disc, and with any potential ongoing development e.g. of AR4021, this could slightly increase the potential for any eruptions resulting in observable protons at GEO.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: SDO Intensitygram/Magnetogram of AR4021 (left) showing emergence of spots to its southwest, and AR4019 (right) showing fading of negative spots



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

High Energy Electrons (≥ 2MeV)

Despite the ongoing fast wind from CH22/-, some outward expansion of the Van Allen belts has been occurring, with periods of high flux observed by GOES-16, and persistently High during this satellites diurnal peak. This is expected to continue, but with a chance of brief period of drop out from any fast wind enhancement either late day 1 or early day 2 (16-17 Mar),. Beyond this, a gradual and erratic decay of the observed flux likely, similar to on the previous rotation, although likely occurring slower than this suggests. Further periods of High flux are likely, but peak values are likely to be gradually declining with the periods of High flux also decreasing.

The associated 24 hour fluence is expected to continue at Active day 1-2 (16-17 Mar), but with confidence for this to persist days 3-4 (18-19 Mar) falling. This is supported by 27-day recurrence. MOSWOC REFM is currently overestimating the observed flux, and subsequently the forecast values from this model are also likely over-estimated.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	Yes	100	80	60	30
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2025. All Rights Reserved.

Figure 6: GOES16 Electron Flux (top) and 24 hr fluence with REFM and 27 day Recurrence (bottom)

© Crown Copyright 2025. All Rights Reserved.